

Significant figures

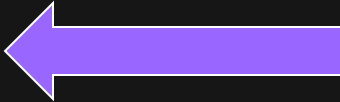
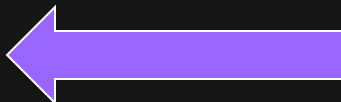
There are 2 kinds of numbers:

Exact: the amount of money in your account.
Known with certainty. Anything *COUNTED*

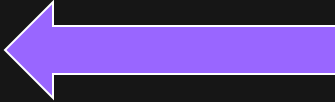
Approximate: weight, height—anything
MEASURED. No measurement is perfect.

Recall

A. Exact numbers are obtained by

1. using a measuring tool
2. counting 
3. definition 

B. Measured numbers are obtained by

1. using a measuring tool 
2. counting
3. definition

Practice

Classify each of the following as an exact or a measured number.

1 yard = 3 feet

The diameter of a red blood cell is 6×10^{-4} cm.

There are 6 hats on the shelf.

Gold melts at 1064°C .

When to use Sig Figs

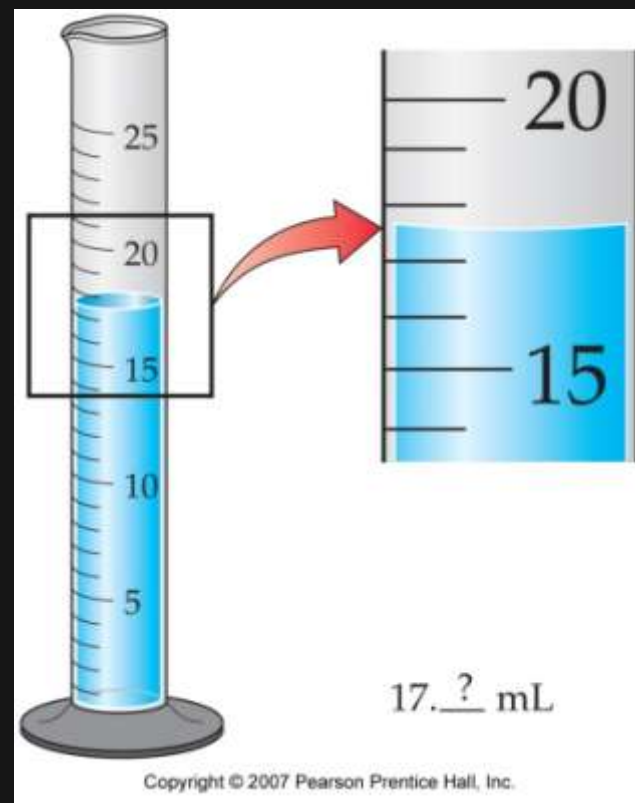
When a measurement is recorded only those digits that are **dependable** are written down.

Every experimental measurement has a degree of uncertainty.

The volume, V , at right is certain in the 10's place, $10\text{mL} < V < 20\text{mL}$

The 1's digit is also certain, $17\text{mL} < V < 18\text{mL}$

A best guess is needed for the tenths place.



Another Example

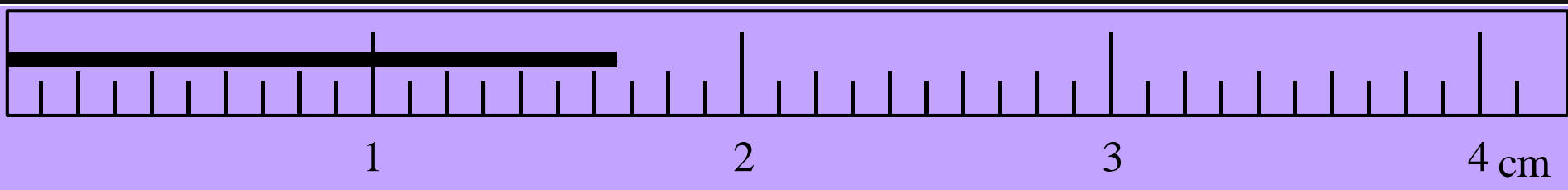
We can see the markings between 1.6-1.7cm

We can't see the markings between the .6-.7

We must guess between .6 & .7

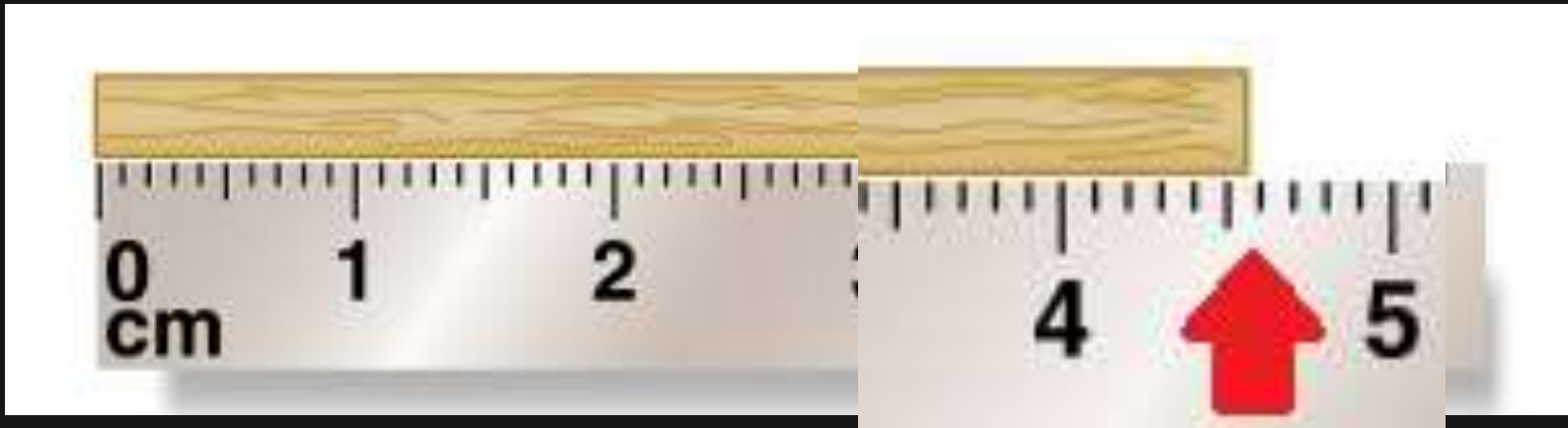
We record 1.67 cm as our measurement

The last digit an 7 was our guess...stop there



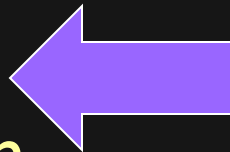
Your Turn

Measured Numbers have error...you have to make that Guess!



What is the length of the wooden stick?

- 1) 4.5 cm
- 2) 4.54 cm
- 3) 4.547 cm



Recorded Numbers

Uncertain digit
54.07 g A mass between 54.06 g and 54.08 g (± 0.01 g)

Uncertain digit
54.071 38 g A mass between 54.071 37 g and 54.071 39 g ($\pm 0.000\ 01$ g)

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All but one of the significant figures are known with certainty. The last sig. fig. is only to the best possible estimate.

To indicate the precision of a measurement, the value recorded should use all the digits known with certainty.

The Rules

RULE 1. Zeros in the middle of a number are like any other digit; they are always significant.

Ex. 45.081 g has **five** significant figures.

RULE 2. Zeros at the beginning of a number are not significant; they act only to locate the decimal point.

Ex. 0.0537 cm has **three** significant figures,
and **0.069 01 mL** has? **4**

The Rules cont.

RULE 3. Zeros at the end of a number and *after* the decimal point are significant. It is assumed that these zeros would not be shown unless they were significant.

Ex. 527.700 m has **six** significant figures.

If the value were known to only four significant figures, we would write 527.7 m.

The Rules cont.

RULE 4. Zeros at the end of a number and *before* an implied decimal point may or may not be significant. We cannot tell whether they are part of the measurement or whether they act only to locate the unwritten but implied decimal point.

Ex. 280 000km has 2 sig. figs.

How Many Sig Figs?

a. 45.8736

b. 0.000239

c. 0.00023900

d. 48000.

e. 48000

f. 3.982×10^6

g. 1.00040

Scientific Notation

When ever you are unsure – convert to scientific notation

$$215. = 2.15 \times 10^2$$



Decimal point is moved two places to the left, so exponent is 2.

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$$3.7962 \times 10^4 = 37,962$$


Positive exponent of 4, so decimal point is moved to the right four places.

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$$1.56 \times 10^{-8} = 0.000\ 000\ 015\ 6$$


Negative exponent of -8 , so decimal point is moved to the left eight places.

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Adding and Subtracting

Rule: When adding or subtracting measured numbers, the answer can have no more places after the decimal than the **LEAST** of the measured numbers.

Practice

$$5.45\text{cm} + 2.3\text{cm} = 7.75\text{cm},$$

$$\text{Round off to } = 7.8\text{cm}$$

You try:

$$7.432\text{cm} + 2\text{cm} =$$

$$9.432 \text{ round to } \rightarrow 9\text{cm}$$

Multiplications and Division

Rule: When multiplying or dividing, the result can have no more significant figures than the **least** reliable measurement.

Practice

$$56.78 \text{ cm} \times 2.45 \text{ cm} = 139.111 \text{ cm}^2$$

Round to $\rightarrow 139 \text{ cm}^2$

$$75.8 \text{ cm} \times 9.6 \text{ cm} = ?$$

Bell Work

28-Aug-2015 Pre - AP

A man in a restaurant asked a waiter for a juice glass, a dinner plate, water, a match, and a lemon wedge. The man poured water on the plate to cover it.

"If you can get the water on the plate into this glass without touching or moving this plate, I will give you \$100," the man said. "You can use the match and lemon to do this."

A few minutes later, the waiter walked away with \$100 in his pocket. ***How did the waiter get the water into the glass?***

Objective

You will be able to determine the density of a metal after finding its mass and volume.

You will learn a fast method for finding volume.

Pre Lab

**Use as many
piece of paper
as you need, try
not to write on
both side.**

Analysis and conclusions should be recorded at the end of the pre lab after the lab

Title

Purpose/ Objective: _____

Safety: _____

Pre lab Calculations: _____

Procedures

↓

Data Table:

Name _____

Period _____

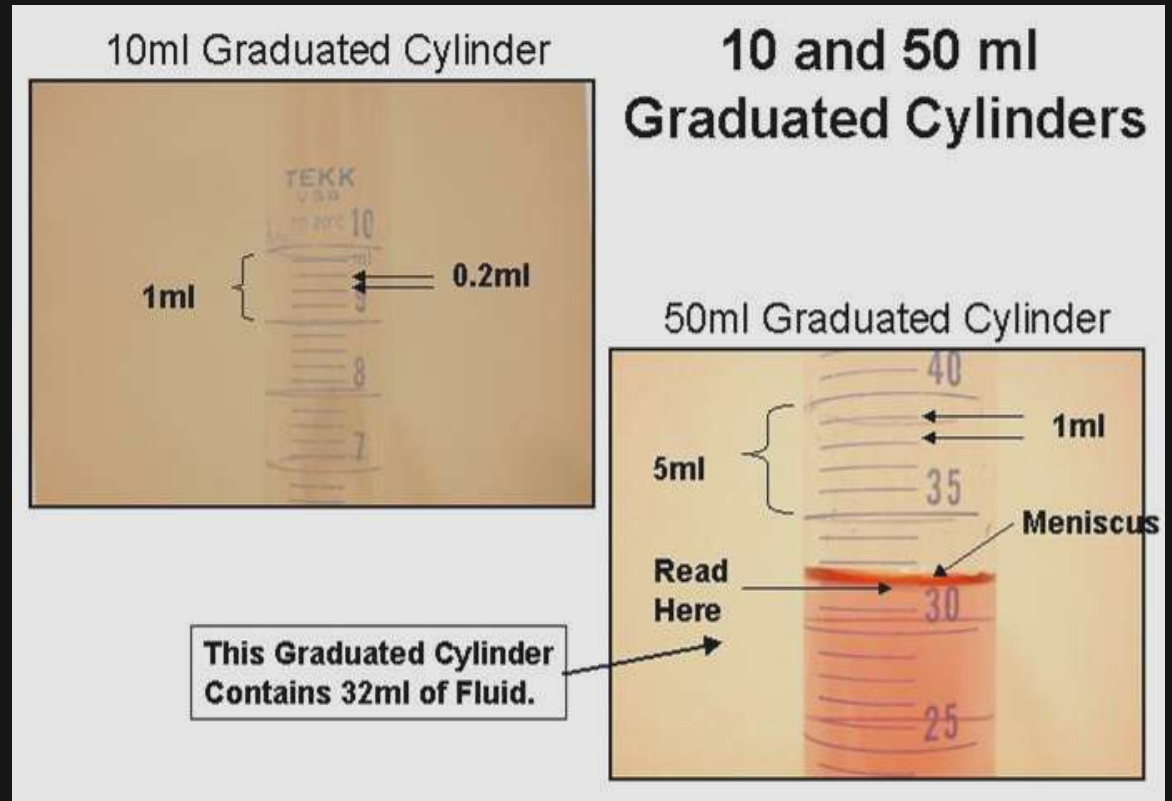
Date _____

Observations

↓

Reading a Graduated Cylinder

What do you think is the volume of the solution in your graduated cylinder?



Density Lab

*There are **eight (8)** different metals, **A-H**,
you will work each and rotate through
the lab*

Each metal type needs a minimum of three (3)
different samplings of volume and mass.

Dry metals before weighing, all sphere metals
use weigh boats

Density Lab

Safety: **Do Not** touch the lead, Pb, with your fingers or hand. **No Toces El Plomo**

When using the **Pb** and "G" use 15 balls at a time.

So 15, 30, 45, _____ etc. when measuring

Follow directions!

When finished, record data on board for class to copy down for graphs.

Before you leave...

What laboratory tool could you use to find the volume of a metal nut?

How would you carry out the measurement?

What should you be sure to do to insure the volume is measured correctly?



When finished record data on board for class to copy down for graphs.

Email graph to: william.golden@fwusd.org

Subject: P.X.LastName.FirstName.Density

Bell work

31-Aug-2015

If a clay brick measures 20.0cm x 10.0cm x 10cm,
what is the volume of the brick, in mm³?



EQ: Suppose there are three parts to learning in school; student, teacher, and content/material. What is your role as a student including responsibilities and expectations

Agenda:

Finish density lab and record all data as a class.

Recap

What did we do in the lab Friday day?

What two (2) measurements did we make?

Intensive property: Independent of the quantity or amount (Melting point, density, Molar Mass, etc.)

Extensive property: Depends on the amount. (Mass, volume, temperature, measurements)

Actual Density Values for percent Error

1. Person from each group:

**Please come up to board and enter any
one of your values you measured for
each sample**

2. Take a picture or look up data on class website in power point section

Average Vol. & Mass Period 1

Average Vol. & Mass Period 1

A		B		C		D	
Mass (g)	Vol. (cm ³)	Mass (g)	Vol. (cm ³)	Mass (g)	Vol. (cm ³)	Mass (g)	Vol. (cm ³)
1g	0.1cm ³	197.19g 665g	59cm ³ 18cm ³	45.9g	5cm ³	34.2g	5cm ³
2g	0.2cm ³	127.8g	41cm ³	3.3g	1cm ³	510g	5cm ³
3g	0.3cm ³	183.7g	59cm ³	6.2g	1cm ³	85.1g	20cm ³
29.2	4cm ³			19g	2cm ³	167.7g	30cm ³
4.4g	1cm ³	66.4g	26cm ³	12.6g	1.5cm ³	144.9g	30cm ³
E		F		G		H	
Mass (g)	Vol. (cm ³)	Mass (g)	Vol. (cm ³)	Mass (g)	Vol. (cm ³)	Mass (g)	Vol. (cm ³)
147g	60cm ³	28.4g	16cm ³	32.8g	4cm ³	3.2g	2.1cm ³
97.3g	50cm ³	3.6g	1cm ³	29.1	4	1.0g	0.1cm ³
49.7g	24cm ³	8.6g	4	3	1	1.1g	0.3cm ³
147g	74cm ³	130g	6	8.7	1	1.1g	0.2cm ³
97.59g	40cm ³	16.6g	7	15	1.5	2.1g	1.3cm ³

Average Vol. & Mass Period 2

Average Vol. & Mass Period 2

A		B		C		D	
Mass (g)	Vol. (cm ³)	Mass (g)	Vol. (cm ³)	Mass (g)	Vol. (cm ³)	Mass (g)	Vol. (cm ³)
29.2	3.5	61.2	22	1.1 ¹⁵	0.1 cm ³	34.3	8.0
33.5	4.5	66.4	24	2.2 ³⁰	0.2 cm ³	182.5	40
38.0	5.0	30.5	13	3.2 ¹⁵	0.4 cm ³	202.1	40
29.2	4.0			8.5	/	138.8	30
29.1	4					167.8	35
E		F		G		H	
Mass (g)	Vol. (cm ³)	Mass (g)	Vol. (cm ³)	Mass (g)	Vol. (cm ³)	Mass (g)	Vol. (cm ³)
49.8	20	6.9	3	11.8	2.0	0.7	0.1
50.1	20	7.5	3	9.2	1		
125.1	50	15.5	6				

Average Vol. & Mass Period 3

A	
Mass (g)	Vol. (cm ³)
29.2	7
33.5	5
29.2	4
29.2	3
29.2	5

B	
Mass (g)	Vol. (cm ³)
66.5	24
66.4	24
30.4	12

C	
Mass (g)	Vol. (cm ³)
2.7	1
7.4	2
5.5	1
12.6	2

D	
Mass (g)	Vol. (cm ³)
144.6	10
28.1	13
50	20
19.1	4
167.8	3

E	
Mass (g)	Vol. (cm ³)
49.4	20
50.0	11ml

F	
Mass (g)	Vol. (cm ³)
30.3	14
14.1	6
4.4	1

G	
Mass (g)	Vol. (cm ³)
5.7	1
15	1
6.2	2.1
9.3	3
3.1	1

H	
Mass (g)	Vol. (cm ³)
1	0.2
1.0	0.1
2.1	0.2